

### Claims:

1. A high-density circuit module comprising:

a first flex circuit having first and second conductive layers between which conductive layers is an intermediate layer, the first and second conductive layers being interior to first and second outer layers of the first flex circuit, the second conductive layer having upper and lower flex contacts, the upper flex contacts being accessible through second CSP windows through the second outer layer and the lower flex contacts being accessible through first CSP windows through the first outer layer, the first conductive layer and the intermediate layer, the lower flex contacts being further accessible through module contact windows through the second outer layer;

a second flex circuit having first and second conductive layers between which conductive layers is an intermediate layer, the first and second conductive layers being interior to first and second outer layers of the second flex circuit, the second conductive layer having upper and lower flex contacts, the upper flex contacts being accessible through second CSP windows through the second outer layer and the lower flex contacts being accessible through first CSP windows through the first outer layer and the first conductive layer and the intermediate layer, the lower flex contacts being further accessible through module contact windows through the second outer layer;

a first CSP having first and second lateral sides and upper and lower major surfaces with contacts along the lower major surface, the contacts of the first CSP extending no further than 7 mils above the lower major surface of the first CSP and being connected to the lower flex contacts of the first and second flex circuits;

a second CSP having first and second lateral sides and upper and lower major surfaces with contacts along the lower major surface, the contacts of the

second CSP extending no further than 7 mils above the lower major surface of the second CSP and being connected to the upper flex contacts of the first and second flex circuits;

a form standard disposed above the upper major surface of the first CSP; and

a set of module contacts connected to the lower flex contacts of the first and second flex circuits.

2. The high-density circuit module of claim 1 in which the second conductive layer comprises at least one demarked voltage plane and a voltage set of the upper flex contacts and a voltage set of the lower flex contacts connect voltage conductive contacts of the first and second CSPs to one of the at least one voltage planes.

3. A high-density circuit module comprising:

a first CSP having an upper surface and a lower surface and a body with a height H1 that is the shortest distance from the upper surface to the lower surface of the first CSP, and along the lower surface there are plural first CSP low profile contacts, each of which plural first CSP low profile contacts extends no more than 7 mils from the surface of the first CSP;

a second CSP in stacked disposition with the first CSP, the second CSP having an upper surface and a lower surface and a body with a height H2 that is the shortest distance from the upper surface to the lower surface of the second CSP, and along the lower surface there are plural second CSP low profile contacts, each of which plural second CSP low profile contacts extends no more than 7 mils from the surface of the second CSP;

a first flex circuitry that connects the first CSP and the second CSP, a portion of which flex circuitry is disposed between the first and second CSPs.

4. The high-density circuit module of claim 3 in which the plural first CSP low profile contacts and the plural second CSP low profile contacts are HT joints.

5. The high-density circuit module of claim 4 in which plural module contacts are disposed along the first flex circuitry.

6. The high-density circuit module of claims 3 or 4 in which the shortest distance from the lower surface of the second CSP to the upper surface of the first  
10 CSP that passes through one of the plural second CSP low profile contacts is less than 11 mils.

7. The high-density circuit module of claim 3 in which the first flex circuitry is comprised of two flex circuits, each of which flex circuits has two conductive layers.

8. The high-density circuit module of claim 3 in which the shortest distance from the lower surface of the second CSP to the upper surface of the first CSP that passes through one of the plural second CSP low profile contacts is no more than 9  
20 mils.

9. The high-density circuit module of claim 8 in which the first flex circuitry is comprised of two flex circuits, each of which flex circuits has one conductive layer.

10. The high-density circuit module of claim 3 further comprising a form standard disposed above the upper surface of the first CSP and in which the

shortest distance from the lower surface of the second CSP to the upper surface of the first CSP that passes through one of the plural second CSP low profile contacts is no more than 17 mils.

11. The high-density circuit module of claim 3 further comprising:

a first form standard disposed above the upper surface of the first CSP; and

the first flex circuitry is comprised of two flex circuits, each of which flex circuits has two conductive layers at least one of which conductive layers has plural flex contacts and in which the shortest distance from the lower surface of the second CSP to the upper surface of the first CSP that passes through one of the plural second CSP low profile contacts is no more than 17 mils

12. The high-density circuit module of claim 10 in which the first flex circuitry is comprised of two flex circuits each of which flex circuits has one conductive layer.

13. The high-density circuit module of claim 11 in which the plural first CSP low profile contacts and the plural second CSP low profile contacts are HT joints, selected ones of which HT joints are in contact with flex contacts of the first flex circuitry.

14. The high-density circuit module of claim 13 further comprising module contacts.

15. The high-density circuit module of claim 3 further comprising:

a third CSP having an upper surface and a lower surface and a body with a height H3 that is the shortest distance from the upper surface to the lower surface,

and along the lower surface there are plural third CSP low profile contacts, each of which plural third CSP low profile contacts extends no more than 7 mils from the surface of the third CSP;

a fourth CSP in stacked disposition with the third CSP, the fourth CSP having an upper surface and a lower surface and a body with a height H4 that is the shortest distance from the upper surface to the lower surface, and along the lower surface there are plural fourth CSP low profile contacts, each of which plural fourth CSP low profile contacts extends no more than 7 mils from the surface of the fourth CSP, the third CSP being disposed above the second CSP and the fourth  
10 CSP being disposed above the third CSP; and

a second flex circuitry connecting the second CSP and the third CSP; and

a third flex circuitry connecting the third CSP and the fourth CSP.

16. The high-density circuit module of claim 15 in which the first CSP is disposed beneath the second CSP and the shortest distance from the upper surface of the fourth CSP to the lower surface of the first CSP that passes through at least one of the plural fourth CSP low profile contacts is less than HEIGHT where  $\text{HEIGHT} = 45 \text{ mils} + H1 + H2 + H3 + H4$ .

20 17. The high-density circuit module of claim 15 further comprising first, second and third form standards each respectively disposed above the upper surface of the first, second, and third CSPs.

18. The high-density circuit module of claim 17 in which the shortest distance from the upper surface of the fourth CSP to the lower surface of the first CSP that passes through at least one of the plural fourth CSP low profile contacts is less than HEIGHTFS where  $\text{HEIGHTFS} = 65 \text{ mils} + H1 + H2 + H3 + H4$ .

19. The high-density circuit module of claim 11 further comprising:

a third CSP having an upper surface and a lower surface and a body with a height H3 that is the shortest distance from the upper surface to the lower surface, and along the lower surface there are plural third CSP low profile contacts, each of which plural third CSP low profile contacts extends no more than 7 mils from the surface of the third CSP;

a fourth CSP in stacked disposition with the third CSP, the fourth CSP having an upper surface and a lower surface and a body with a height H4 that is the shortest distance from the upper surface to the lower surface, and along the lower surface there are plural fourth CSP low profile contacts, each of which plural fourth CSP low profile contacts extends no more than 7 mils from the surface of the fourth CSP, the third CSP being disposed above the second CSP and the fourth CSP being disposed above the third CSP; and

a second flex circuitry connecting the second CSP and the third CSP, the second flex circuitry being comprised of two conductive layers at least one of which two conductive layers has plural flex contacts; and

a third flex circuitry connecting the third CSP and the fourth CSP, the second flex circuitry being comprised of two conductive layers at least one of which two conductive layers has plural flex contacts; and

second and third form standards respectively disposed above the second and third CSPs.

20. The high density circuit module of claim 19 in which at least one of the flex contacts has an orifice.

21. The high density circuit module of claim 19 in which the first, second, and third form standards are comprised of copper.

22. The high density circuit module of claim 19 in which the shortest distance from the lower surface of the fourth CSP to the upper surface of the first CSP that passes through one of the plural fourth CSP low profile contacts is less than HEIGHT4 where  $\text{HEIGHT4} = 65 \text{ mils} + H1 + H2 + H3 + H4$ .

23. A high density circuit module comprising:

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a first CSP;

a second CSP, the second CSP being disposed above the first CSP;

flex circuitry connecting the first CSP and the second CSP, the flex circuitry having plural flex contacts of which at least one has an orifice that has a median opening extent of DO; and

plural consolidated contacts, a selected one of which passes through the orifice and the selected one of the plural consolidated contacts having an inner flex portion and an outer flex portion delineated by the orifice, the selected one of the plural consolidated contacts providing a connection between the first CSP and the flex circuitry and the outer flex portion of the selected one of the plural consolidated contacts having a median lateral extent of DCC and DCC is larger than DO.

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24. A high density circuit module comprising:

a first CSP;

flex circuitry; and

a second CSP in a stacked relationship with the first CSP, the second CSP having plural consolidated contacts each of which is one piece of metal that has

been melted to pass in part through the flex circuitry to provide a connection between the second CSP and the flex circuitry and a module connective facility.

25. A high-density circuit module comprising:

a first flex circuit having first and second flex contacts;

a second flex circuit having first and second flex contacts;

a first CSP having a lower surface rising above which lower surface by no more than 7 mils are contacts that are connected to the first flex contacts of each of the first and second flex circuits;

10 a second CSP having a lower surface rising above which lower surface by no more than 7 mils are contacts that are connected to the second flex contacts of each of the first and second flex circuits; and

a set of module contacts connected to the second flex contacts.

26. The high-density circuit module of claim 25 further comprising a heat spreader.

27. The high density circuit module of claim 26 further comprising a form standard.

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28. A method of devising a high-density circuit module comprising the steps of:  
providing a first CSP having a plurality of ball contacts disposed along a major surface;

providing flex circuitry having a plurality of selected flex contacts each penetrated by an orifice;

disposing the first CSP proximal to the flex circuitry to place the plurality of ball contacts adjacent to the plurality of flex contacts;



applying heat sufficient to melt the plurality of ball contacts.

29. The method of claim 28 further comprising the step of disposing a second CSP above the first CSP and connecting the first and second CSPs with the flex circuitry.

30. The method of claim 28 in which the flex circuitry is comprised of two flex circuits.

10 31. The method of claim 28 in which the flex circuitry has two conductive layers.

32. A method of devising a high-density circuit module comprising the steps of:  
providing a first CSP having contact sites along a major surface;  
providing a second CSP having contact sites along a major surface;  
providing flex circuitry having plural flex contacts;  
disposing solder to connect selected contact sites of the first CSP to a first set of the plural flex contacts so that the shortest distance from the major surface of the first CSP to a surface of the flex circuitry is between 1 and 6 mils inclusive.

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33. The method of claim 32 further comprising the step of disposing solder to connect selected contact sites of the second CSP to a second set of the plural flex contacts so that the shortest distance from the major surface of the second CSP to a surface of the flex circuitry is between 1 and 6 mils inclusive.

34. The method of claim 33 in which the flex circuitry has two conductive layers.

35. The method of claim 34 in which the flex circuitry is comprised of two flex circuits.